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EXAMINER
PAREKH, NITIN

ART UNIT	PAPER NUMBER
2811	12

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/462,796	Applicant(s) Watanabe et al
	Examiner Nitin Parekh	Art Unit 2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Nov 19, 2001*

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle* 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *2-7 and 9-33* is/are pending in the applica

4a) Of the above, claim(s) *22* is/are withdrawn from considera

5) ☐ Claim(s) ______ is/are allowed.

6) ☒ Claim(s) *2-7, 9-21, and 23-33* is/are rejected.

7) ☐ Claim(s) ______ is/are objected to.

8) ☐ Claims ______ are subject to restriction and/or election requirem

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on ______ is/are objected to by the Examiner.

11) ☒ The proposed drawing correction filed on *Jun 8, 2001* is: a) ☒ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☒ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☒ All b) ☐ Some* c) ☐ None of:

1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ______.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☒ Notice of References Cited (PTO-892)

16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). *1*

18) ☐ Interview Summary (PTO-413) Paper No(s). ______

19) ☐ Notice of Informal Patent Application (PTO-152)

20) ☐ Other:

DETAILED ACTION

A. In response to the arguments traversing the election of species, claims 2, 6, 8, 9, 12, 13, 16, 17, 20, 26, 27, 30 and 31 (Embodiments I and III) have been examined in this office action since these claims share many common features with those of Embodiment II.

B. Claims 1 and 8 are canceled.

C. The references cited in the International Search Report have been considered.

Election/Restriction

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-21 and 23-33, drawn to a semiconductor device, classified in class 257, subclass 678.

II. Claim 22, drawn to a method of making a semiconductor device, classified in class 438, subclass 106.

2. The inventions are distinct, each from the other because of the following reasons: Inventions II and I are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case unpatentability of Group I invention would not necessarily imply unpatentability of the process of the group II invention, since the device of group I invention could be made by the processes

different from those of group II invention. For example, by using a laser etching/drilling method to form pyramidal holes instead of photolithographic etching.

3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 2-4, 6, 7 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tago et al (US Pat. 5508561) in view of Hosomi et al (US Pat. 6049130) and prior art (IDS-paper #1; Takahiro et al- Japanese Pat. 08191072 and Yoshikazu- Japanese Pat. 09148378).

Regarding claim 2, Tago et al disclose a semiconductor device (Fig. 14B; Col. 9, line 40- Col. 10, line 32) having a plurality of truncated cone shaped bump electrodes (6a/4a/4b; Col. 7, line 19- Col. 7, line 63) bonded by thermal compression (Col. 7, line 35) onto pad electrodes (2 in Fig. 14B) arranged on the semiconductor chip (1 in Fig. 14B).

Tago et al further disclose processes such as soldering (Col. 10, line 27) or using an adhesive/conductive resin/film (Col. 10, line 24) to bond the pyramidal/conical bump electrodes to the terminals formed on the substrate.

Tago et al fail to specify the bumps being in the shape of a pyramid and being bonded through an anisotropic conduction film.

However, Fig. 14B in Tago et al's device shows the bumps resembling a shape of a truncated cone or pyramid with a curved dome/tip. Hosomi et al teach using pyramid shaped bumps using conventional thermal compression (6/7 in Fig. 20; Col. 1, line 45- Col. 2, line 68).

The prior art reference (IDS-paper #1; Japanese Pat. 08191072; Fig. 2; Col. 1-3) show a variety of shapes including triangular/conical/square shaped pyramidal bumps bonded onto pad electrodes.

The prior art reference (Yoshikazu) teaches using conventional anisotropic conduction film (15 in Fig. 2; pp. 1-5) for bonding the bump and pad electrodes.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time invention was made to choose pyramidal shaped bump electrodes being bonded through an

anisotropic conduction film to achieve the desired bonding strength and adhesion using Hosomi et al's and prior art bump shape/structure in Tago et al's device.

Regarding claim 3, Tago et al disclose a semiconductor device (Fig. 14B; Col. 9, line 40- Col. 10, line 32) having a plurality of truncated cone shaped bump electrodes (6a/4a/4b; Col. 7, line 19- Col. 7, line 63) bonded by thermal compression (Col. 7, line 35) onto pad electrodes (2 in Fig. 14B) arranged on the semiconductor chip (1 in Fig. 14B).

Tago et al fail to specify the bumps being in the shape of a pyramid. However, Fig. 14B in Tago et al's device shows the bumps resembling a shape of a truncated cone or pyramid with a curved dome/tip. Hosomi et al teach using pyramid shaped bumps using conventional thermal compression (6/7 in Fig. 20; Col. 1, line 45- Col. 2, line 68).

The prior art reference (IDS-paper #1; Japanese Pat. 08191072; Fig. 2; Col. 1-3) show a variety of shapes including triangular/conical/square shaped pyramidal bumps bonded onto pad electrodes.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time invention was made to choose pyramidal shaped bump electrodes to achieve the desired bonding strength using Hosomi et al's and prior art bump shape in Tago et al's device.

Regarding claims 6 and 7, Tago et al further disclose the bump electrodes being made of a material selected from a group consisting copper (Cu), Nickel (Ni), gold (Au), etc. (Col. 9, line 40).

Regarding claim 4, as explained above for claim 3, Tago et al disclose using the bump electrodes of metals such as Ni, Au, etc. and bonding them onto pad electrodes by conventional thermal compression but Tago et al fail to specify that an alloy can be formed at their junctions by using conventional heating and compression processes.

Hosomi et al teach using the cone/pyramid shaped bumps using conventional thermal compression where a layer comprising an alloy such as Au/Sn (9/8 in Fig. 20; Col. 1, line 45-Col. 2, line 68) is formed at the junction due to intermetallic diffusion.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate pyramidal shaped bump electrodes and pad electrodes which can form an alloy at the junctions to achieve the desired bonding strength using Hosomi et al and prior art structure in Tago et al's device.

Regarding claim 23, as explained above for claims 6 and 7, Tago et al further disclose the bump electrodes being made of a material selected from a group consisting copper (Cu), Nickel (Ni), gold (Au), etc. (Col. 9, line 40).

6. Claims 5 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tago et al (US Pat. 5508561) in view of Hosomi et al (US Pat. 6049130) and prior art (IDS-paper #1; Takahiro et al- Japanese Pat. 08191072 and Yoshikazu- Japanese Pat. 09148378) and further in view of Chigawa et al (US Pat. 6172422).

Regarding claim 5, as explained above for claim 3, Tago et al in view of Hosomi et al and Takahiro et al disclose using the pyramidal/conical bump electrodes bonded onto pad electrodes but fail to specify bonding them onto rewired metal conduction pads electrically connected to pad electrodes arranged on a semiconductor chip.

Chigawa et al teach bonding pyramidal/conical bump electrodes onto rewired conductive/metal substrate pad (6a/6 in Fig. 32A-34C; Col. 14, line 44; Fig. 38) which are electrically connected to pad electrodes arranged on a semiconductor chip.

Owada et al (US Pat. 5027188) teach using conventional rewired metal/connection pads (42 in Fig. 6; Col. 7) on the substrate (41 in Fig. 6) for a flipchip bonding.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the pyramidal bump electrodes bonded onto rewired metal conduction pads electrically connected to pad electrodes arranged on a semiconductor chip to achieve increased interconnection capability using Chigawa et al's wiring design in Tago et al's device in view of Hosomi et al and prior art.

Regarding claim 24, as explained above for claims 6 and 7, Tago et al further disclose the bump electrodes being made of a material selected from a group consisting copper (Cu), Nickel (Ni), gold (Au), etc. (Col. 9, line 40).

7. Claims 9-21 and 25-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tago et al (US Pat. 5508561) in view of Hosomi et al (US Pat. 6049130) and prior art (IDS-paper #1; Japanese Pat. 08191072 and Yoshikazu- Japanese Pat. 09148378).

Regarding claim 9, Tago et al further disclose a mounting structure comprising:

- a semiconductor device (Fig. 14B; Col. 9, line 40- Col. 10, line 32) having a plurality of truncated cone shaped bump electrodes (6a/4a/4b; Col. 7, line 19- Col. 7, line 63) bonded by thermal compression (Col. 7, line 35) onto pad electrodes (2 in Fig. 14B) arranged on the semiconductor chip (1 in Fig. 14B), and

- the mounting structure enabling the semiconductor device to be mounted on a substrate (5 in Fig. 14B) by bonding the bump electrodes onto the terminals (26 in Fig. 14B) formed on the substrate

As explained above for claim 2, Tago et al fail to specify the bumps being in the shape of a pyramid and being bonded through an anisotropic conduction film.. However, Fig. 14B in Tago et al's structure shows the bumps resembling a shape of a truncated cone or pyramid with a curved dome/tip.

Hosomi et al teach using pyramid shaped bumps using conventional thermal compression (6/7 in Fig. 20; Col. 1, line 45- Col. 2, line 68).

The prior art reference (IDS-paper #1; Japanese Pat. 08191072; Fig. 2; Col. 1-3) show a variety of shapes including triangular/conical/square shaped pyramidal bumps bonded onto pad electrodes.

The prior art reference (Yoshikazu) teaches using conventional anisotropic conduction film (15 in Fig. 2; pp. 1-5) for bonding the bump and pad electrodes.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time invention was made to choose pyramidal shaped bump electrodes to achieve the desired bonding strength in Tago et al's structure in view of Hosomi et al and prior art.

Regarding claim 10, Tago et al disclose a mounting structure comprising:

- a semiconductor device (Fig. 14B; Col. 9, line 40- Col. 10, line 32) having a plurality of truncated cone shaped bump electrodes (6a/4a/4b; Col. 7, line 19- Col. 7, line 63) bonded by thermal compression (Col. 7, line 35) onto pad electrodes (2 in Fig. 14B) arranged on the semiconductor chip (1 in Fig. 14B), and

- the mounting structure enabling the semiconductor device to be mounted on a substrate (5 in Fig. 14B) by bonding the bump electrodes onto the terminals (26 in Fig. 14B) formed on the substrate

As explained above for claim 3, Tago et al fail to specify the bumps being in the shape of a pyramid. However, Fig. 14B in Tago et al's structure shows the bumps resembling a shape of a truncated cone or pyramid with a curved dome/tip.

Hosomi et al teach using pyramid shaped bumps using conventional thermal compression (6/7 in Fig. 20; Col. 1, line 45- Col. 2, line 68).

The prior art reference (IDS-paper #1; Japanese Pat. 08191072; Fig. 2; Col. 1-3) show a variety of shapes including triangular/conical/square shaped pyramidal bumps bonded onto pad electrodes.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time invention was made to choose pyramidal shaped bump electrodes to achieve the desired bonding strength in Tago et al's structure in view of Hosomi et al and prior art.

Regarding claims 20 and 21, as explained above for claims 6 and 7, Tago et al further disclose the bump electrodes being made of a material selected from a group consisting copper (Cu), Nickel (Ni), gold (Au), etc. (Col. 9, line 40). Claim 21 is rejected as explained above for claims 10, 3 and 7.

Regarding claims 11, 15, 19, as explained above for claim 4, Tago et al further disclose a mounting structure enabling the semiconductor device to be mounted on a substrate (5 in Fig. 14B) by bonding the bump electrodes onto the terminals (26 in Fig. 14B) formed on the substrate

using processes such as soldering (Col. 10, line 27) or using an adhesive/conductive resin (Col. 10, line 24) to bond the pyramidal/conical bump electrodes to the terminals formed on the substrate.

Regarding claims 25, 29 and 33, as explained above for claims 6 and 7, Tago et al further disclose the bump electrodes being made of a material selected from a group consisting copper (Cu), Nickel (Ni), gold (Au), etc. (Col. 9, line 40).

Regarding claims 12-14 and 16-18, as explained above for claims 9 and 10, Tago et al further disclose conventional processes such as soldering (Col. 10, line 27), using an adhesive/conductive resin (Col. 10, line 24), etc. to bond the pyramidal/conical bump electrodes to the terminals formed on the substrate.

Regarding claims 26-28 and 30-32, as explained above for claims 6 and 7, Tago et al further disclose the bump electrodes being made of a material selected from a group consisting copper (Cu), Nickel (Ni), gold (Au), etc. (Col. 9, line 40).

Response to Arguments

8. Applicant's arguments filed on 11-19-01 have been fully considered but they are not persuasive.

A. Applicant contends that Tago et al in view of Hosomi et al (US Pat. 6049130) and prior art (Takahiro et al- Japanese Pat. 08191072) do not teach using bumps having a shape of a pyramid.

However, Fig. 14B in Tago et al's device shows the bumps (6a) resembling a shape of a truncated cone or pyramid with a curved dome/tip bonded by thermal compression (Col. 7, line 35).

As explained above, Hosomi et al teach using pyramid shaped bumps using conventional thermal compression (6/7 in Fig. 20; Col. 1, line 45- Col. 2, line 68) and Takahiro et al (Fig. 2; Col. 1-3) show a variety of shapes including triangular/conical/square shaped pyramidal bumps bonded onto pad electrodes. Therefore, teachings of Hosomi et al and Takahiro et al is applied to incorporate the pyramidal shape in Tago et al's bumps to improve the bonding strength.

B. Applicant contends that Tago et al in view of Hosomi et al do not teach the structure where the pyramidal electrodes and the pad electrode can form an alloy at the junction.

However, as explained above, Tago et al disclose the bumps resembling a shape of a truncated cone or pyramid with a curved dome/tip bonded by thermal compression (Col. 7, line

35). It would be obvious to one of the ordinary skill that such high temperature/pressure exposure can result in a formation of binary alloy at the junction.

Furthermore, Hosomi et al teach using the cone/pyramid shaped bumps using conventional thermal compression where a layer comprising an alloy such as Au/Sn (9/8 in Fig. 20; Col. 1, line 45- Col. 2, line 68) is formed at the junction due to intermetallic diffusion. Therefore, Hosomi et al's teaching forming an alloy at the pyramidal bump/pad electrode junction during thermal compression is applied in Tago et al's device in view of Takahiro et al.

C. Applicant contends that Tago et al in view of Hosomi et al, Takahiro et al and Chigawa - do not teach using rewired metal connection pads.

However, as explained above, Chigawa et al (6a/6 in Fig. 32A-34C; Col. 14, line 44; Fig. 38) and cited reference by Owada et al (Fig. 6; Col. 7) teach bonding pyramidal/bump electrodes onto conventional rewired conductive/metal substrate pad which are electrically connected to pad electrodes arranged on a semiconductor chip respectively. Therefore, Owada et al's rewired metal pad structure is applied to increase interconnection/routing capability in Tago et al's device in view of Hosomi et al and Takahiro et al.

Papers related to this application may be submitted directly to Art Unit 2811 by facsimile transmission. Papers should be faxed to Art Unit via Technology Center 2800 fax center located in Crystal Plaza 4, room 4C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh whose telephone number in (703) 305-3410. The examiner can be normally reached on Monday-Friday from 08:30 am-5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas, can be reached on (703) 308-2772. The fax number for the organization where this application or proceeding is assigned is (703) 308-7722 or 7724.

Nitin Parekh

01-22-02

Tom Thomas

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